

NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 6-87

Subj: Recommended Procedures for Control of Asbestos and Other Respiratory Hazards On Board Merchant Vessels, Outer Continental Shelf (OCS) Facilities and Deepwater Ports

1. PURPOSE. This Circular recommends procedures for controlling potentially hazardous exposure of marine personnel to airborne asbestos and certain mineral fibers and provides guidance in selection of control techniques to reduce such exposure on board merchant vessels, OCS facilities and deepwater ports.
2. PERIODICALS AFFECTED. Navigation and Vessel Inspection Circular (NVIC) 5-80 is canceled.
3. BACKGROUND.
 - a. Ships that were constructed between 1940 and 1975 used substantial amounts of asbestos for insulation and fire protection. Concerns about the health effects from exposure to asbestos have forced limited use, if not total elimination, of this material in the construction of new vessels.
 - b. Initial guidance for control of personnel exposure to asbestos on board vessels and facilities was outlined in NVIC 5-80 dated 13 March 1980. NVIC 5-80 outlined procedures for vessel/facility owners, operators and crew members to identify asbestos hazards and prescribed controls available to minimize the risk of asbestos fiber exposure. At the time that NVIC was issued, several government sponsored studies were underway. Those studies eventually provided more detailed information concerning asbestos exposure.
 - c. On June 20, 1986, the Occupational Safety and Health Administration (OSHA) issued a final rule in the Federal Register (51 FR 22612) that amended the regulations in 29 CFR 51910.1001, concerning occupational exposure to asbestos which was the basis of NVIC 5-80. That rule substantially reduced the exposure level of asbestos to which personnel can safely be subjected.
 - d. Certain mineral and artificial mineral fibers, that have been used as an alternative to asbestos, have been identified by the manufacturers as presenting a possible health hazard when personnel are exposed to concentrations in excess of the manufacturer's permissible exposure level.

jurisdiction over operations where 29 CFR 51910.1001 and 51915 apply. In instances where crew members are engaged in maintenance and repair work as part of their regular shipboard duties, the vessel owner/operator is responsible for the health and safety of the crew members.

- b. Asbestos Exposure. This Circular recommends the use of OSHA's new standards and provides additional guidance as to what action should be taken to reduce overall asbestos exposure. Monitoring and surveillance activities as outlined in this Circular should be implemented to determine if the action level and permissible exposure limit (PEL) are reached so that appropriate medical monitoring and abatement measures are taken to ensure that personnel exposure does not exceed the PEL of 0.2 fiber per cubic centimeter (f/cc).
- c. Suspect Material. Asbestos materials are believed to have been installed on all types of vessels. Enclosure (1) contains a list of commonly encountered asbestos materials. Since visual recognition is unreliable, all suspect material should be considered to contain asbestos unless known otherwise. Suspect materials that are damaged, deteriorated or scheduled for removal can be analyzed at a chemical laboratory using techniques such as high x-ray diffraction techniques to determine the presence of asbestos prior to repair/rebuilding work.
- d. Definitions.
 - (1) "Action Level" - An airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals of 0.1 f/cc of air calculated as an 8-hour time weighted average (TWA).
 - (2) "Asbestos" - For purposes of this NVIC, environmental monitoring, and medical monitoring 'Asbestos' includes both the asbestiforms and non-asbestiforms of chrysotile, amosite, crocidolite, tremolite, anthophyllite, actinolite, and any of these minerals that have been chemically treated and/or altered. For purposes of compliance with OSHA standards contained in 29 CFR, the specific regulatory definitions should be used.
 - (3) "Employee Exposure" - Exposure to airborne asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals that would occur if the employee were not using respiratory protective equipment.
 - (4) "Encapsulation" - Application of a sealant via airless spray equipment to an asbestos-containing material to prevent release of asbestos fibers. A bridging encapsulant is a sealant designed to form a membrane over the surface of an asbestos-containing material. A penetrating encapsulant is a sealant designed to saturate the material to bind the asbestos fibers together and to the other substances in the material.

- (7) "Friable Asbestos" - Where the asbestos-containing material can be easily crushed, crumbled, pulverized or reduced to a powder in the hand. The asbestos may be soft or loosely bound in a matrix.
- (8) "High-Efficiency Particulate Air (HEPA) Filter" - A filter capable of trapping and retaining at least 99.97 percent of 0.3 micrometer diameter mono-disperse particles. [NOTE: On May 12, 1987 (52 FR 17752) OSHA modified the respirator selection tables codified at 29 CFR 51910.1001 Table 1, and 1926.58 Table D-4 to specifically exclude the use of disposable respirators for use in areas with airborne concentrations not in excess of 2 f/cc.]
- (9) "Lagging" - A specific type of enclosure usually reserved for thermal insulation on boilers, machinery and piping. Lagging is the protective jacket or covering placed over the insulation material and made of cloth, tape, paper, cement, metal, and/or board, usually finished with cement, paint or other coating. Friable asbestos-containing material covered with lagging is considered to be non-friable as long as the lagging remains intact.
- (10) "Non-Friable Asbestos" - Where asbestos fibers are firmly bound or encased in the material. These usually are hard asbestos-containing materials (e.g. vinyl/asbestos floor tile) that generally do not generate exposure problems unless disturbed (e.g. scraping, grinding, drilling, etc.).
- (11) "Regulated Area" - An area established to demarcate areas where airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals exceed, or can reasonably be expected to exceed, the PEL.
- 12. "Removal" - Controlled elimination of asbestos that keeps airborne concentrations of asbestos within PEL's through the use of engineering controls and work practices. Short term use of respiratory equipment may be required during the actual removal of the asbestos.
- (13) "Rip-Out" - Uncontrolled elimination of asbestos that keeps airborne concentrations of asbestos above the PEL even with the use of engineering controls and work practices. Long term use of respiratory equipment may be required well after the removal of the asbestos.
- (14) "Tremolite, Anthophyllite, Actinolite" - The non-asbestos form of these minerals, and any of these minerals that have been chemically treated and/or altered. For environmental and medical monitoring purposes these forms are considered to be asbestos, as defined in subparagraph 4.d.(2) above.

- (2) If asbestos exposure exceeding the PEL cannot be prevented, exposure should be controlled using the methods prescribed in enclosures (2), (3), (4) and (5).

f Exposure Monitoring.

- (1) OSHA standards require that monitoring be conducted initially to determine employee exposure to asbestos in their assigned work or other areas that are representative of an 8-hour TWA as specified in 29 CFR 51910.1001(d).
- (2) Periodic monitoring, at intervals not greater than 6 months, should be conducted if exposure to asbestos may reasonably be expected to exceed the action level (0.1 f/cc).

g. Limitation On Fabrication, Installation Or Use. The fabrication, installation or use of asbestos-containing materials should be avoided except for essential applications where no acceptable substitute material exists.

h. General Asbestos Control Alternatives. There are four generic control alternatives for asbestos: repair, encapsulation, enclosure and removal. [NOTE: Non-friable asbestos usually does not require control. However, monitoring of the environmental conditions should always be done to assess the magnitude of the problem because non-friable asbestos can also become airborne if disturbed.

- (1) Although each is a unique approach, they all have the following common features:
 - (a) They all require knowledge of the surface to be controlled based on the purpose of the covering (i.e., fire protection, thermal insulation, decoration), the level of activity in the area, the size of the area under consideration, the thickness of the material, and the method of application (sprayed, bolted, taped, wired, cemented, etc.); and
 - (b) They all require personnel protection during handling which should be accomplished in accordance with the guidelines of this Circular.
- (2) Repair should be considered as the first option in controlling asbestos concentrations whenever possible. The situations that lend themselves best to repair are:
 - (a) Small cracks, breaks, indentations, tears, and gouges in the covering material.
 - (b) Areas of limited deterioration or damage (e.g. small areas of moisture damage) where removal of the non-friable asbestos to a natural

- (3) Enclosures may be constructed as new installations or as adaptations of existing installations. Many friable asbestos materials aboard ship are covered but not enclosed, i.e. not sealed behind an airtight barrier. The use of tape, caulking, or cement may be all that is necessary to complete an enclosure. Lagging may serve as an enclosure for boilers, machinery, and piping insulation. The following factors regarding the characteristics and location of the asbestos material, and the characteristics of the enclosure should be considered:
- (a) The underlying structure must be capable of supporting an enclosure.
 - (b) Construction of the barrier may require drilling or other abrasive handling of asbestos-containing material. Precautionary measures for personnel protection should be followed as specified in 29 CFR 51910.1001.
 - (c) The construction of enclosures may be preferable to removal of asbestos containing material in areas of high activity.
 - (d) The area behind the enclosure must be isolated to the extent that there is no communication with an air plenum or work or living areas.
 - (e) Access to areas behind the enclosure should be restricted or otherwise kept to a minimum.
 - (f) Personnel entering the enclosed areas must observe appropriate protective measures due to the potential for high concentrations of airborne asbestos fibers.
 - (g) The enclosure should be impact resistant.
 - (h) Where lagging is installed and subject to chafing, abrasion, or oil contamination, metal lagging covers should also be installed to protect the enclosure. Where personnel may step on it, a rigid metal cover should be installed.
 - (i) Lagging should fit snugly to the underlying material.
- (4) Encapsulation is generally recommended only for sprayed asbestos surfaces that are not highly friable (e.g. acoustical plaster) and, therefore, has very limited applications aboard ship. It is not recommended for areas subject to vibration, personnel exposure, or frequent disturbance. The key factors to consider for encapsulation are the characteristics and location of the asbestos material, and the characteristics of the encapsulant as follows:
- (a) Encapsulation should not be used in areas subject to vibration. This

- (c) Encapsulation should not be used on material that is deteriorated, delaminated, or shows extensive damage.
- (d) The encapsulating material should have good cohesive and adhesive strength. It should not be applied more than 1 inch thick (the weight of the encapsulant may accelerate the deterioration).
- (e) The material should be resistant to water damage (some encapsulant binders are water soluble).
- (f) Encapsulants should be evaluated based upon the results of the following tests:
 - 1. Adhesion or tensile bond strength; and
 - 2. Fire hazard evaluation:
 - a. Flame spread;
 - b. Smoke generation;
 - c. Toxic combustion products; and
 - d. Flash point/ignition temperature.
- (g) Impact resistance.
- (h) Abrasion resistance.
- (i) Aging resistance, including resistance to water vapor aging (resistance to continuous high heat and humidity), and ultraviolet radiation aging.
- (j) In locations where the installed material must meet Coast Guard fire safety standards (e.g. bulkhead panel), encapsulants applied to their surface must comply with the following:
 - 1. Penetrating encapsulants are to be approved as a non-combustible material under 46 CFR 5164.009.
 - 2. Bridging encapsulants are to be approved as an interior finish under 46 CFR 5164.012.
- (k) Encapsulants should be field tested for specific installations prior to in-service usage.

should be considered first before undertaking large scale removal of asbestos materials. This is due primarily to the difficulty for efficient removal and the increased probability of exposing personnel to a higher concentration of airborne asbestos during the removal process. Existing installations of asbestos materials may be allowed to remain in place as long as they are maintained in an intact condition. The following factors should be considered prior to removal of any asbestos material:

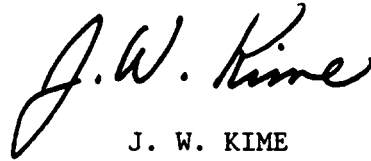
- (a) Asbestos materials damaged by oil or water should be removed in their wet state.
 - (b) Asbestos materials damaged beyond repair, such that the damage is either too extensive or the insulation no longer provides the intended thermal protection, should be removed.
 - (c) Removals beyond the damaged or deteriorated area should be taken to the nearest "natural" boundary (i.e. either section by section or panel by panel removal of pipe insulation or wall covering, respectively, rather than cutting out and inserting new sections or panels).
- i. Guidance For Selecting Controls. Enclosures (6) and (7) provide guidance for selecting a control method and the proper protective equipment to be used when materials containing asbestos are encountered in the maritime industry. [NOTE: On May 12, 1987 (52 FR 17752) OSHA modified the respirator selection tables codified at 29 CFR 1910.1001 Table 1, and 1926.58 Table D-4 to specifically exclude the use of disposable respirators for use in areas with airborne concentrations not in excess of 2 f/cc.)
 - j. Asbestos Exposure Control Training. Enclosure (8) contains information regarding training in Asbestos Exposure Control Procedures.
 - k. Identification. Following the removal of asbestos thermal insulation, the replacement material should be identified as "asbestos free" by the application of a red undercoat sealer (see enclosure (2)). During subsequent removal or repair, the repairer will be able to determine if asbestos or asbestos free insulation is installed by scraping through the exterior paint to determine if a red undercoat is present.
 - 1. Medical Monitoring. Enclosure (9) provides guidance for medical monitoring of personnel occupationally exposed to asbestos.

5. IMPLEMENTATION.

- a. At sea emergency repairs to piping or other equipment or material covered by asbestos-containing material should not be undertaken unless the personnel protection controls contained in enclosure (3) are followed.

- c. It is recommended that owners/operators monitor and document ambient and personnel asbestos exposure levels aboard their vessels or facilities in accordance with 29 CFR 51910.1001 to determine employee exposure to asbestos in their assigned work or other areas based on an 8-hour TWA as follows:
- (1) Survey the vessel or facility for areas suspected of having asbestos-containing materials, reference enclosure (1);
 - (2) Monitor those areas where asbestos-containing material is suspected for at least 8 hours, reference enclosure (5);
 - (3) Initiate personnel training and medical surveillance programs if the action level of 0.1 f/cc (TWA) is exceeded, reference enclosures (8) and (9);
 - (4) If the permissible exposure limit exceeds 0.2 f/cc (TWA):
 - (a) Implement personnel protection controls outlined in enclosure (3).
 - (b) Use enclosure (6) as guidance in determining control measures.
 - (c) Implement asbestos control measures to reduce airborne concentrations of asbestos.
 - (5) periodically monitor those areas that have samplings that exceed the action level. However, in no case should intervals exceed 6 months.
 - (6) Monitor subsequent to shipyard or other repairs those areas involving asbestos-containing material.
- d. Where possible, the exposure of unprotected personnel to airborne asbestos should be prevented. If exposure cannot be prevented, it is recommended that exposure be controlled in a manner consistent with the guidance provided in this Circular.

account during the selection of a contractor include the overall qualifications and reputation, experience and training, and willingness to perform work in accordance with detailed work specifications.



J. W. KIME
Rear Admiral, U.S. Coast Guard
Chief, Office of Marine Safety,
Security and Environmental Protection

- End: (1) Frequently Encountered Asbestos-Containing Materials
(2) Asbestos Work Practice Controls
(3) Personnel Protective Controls Involving the Disruption of Asbestos
(4) Asbestos Ventilation Controls for Working Environments
(5) Personnel and Environmental Monitoring of Asbestos Exposure
(6) Recommended Asbestos Control Techniques
(7) Asbestos Protective Equipment List
(8) Asbestos Exposure Control Training
(9) Medical Monitoring and Surveillance Guidelines

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C:m New Orleans (140); New York (70); Philadelphia (35); Houston (25); St. Ignace (5); Sturgeon Bay (4).

D:I CG Liaison Officer MILSEALIFTCOMD M-4E4, CG Liaison Officer JUSMAGPHIL (1).

ZTC-68

2. Thermal insulation cement
3. Speckling, joint cement and wall patching compounds
4. Cement sheet and siding
5. Floor tile
6. Deck coverings
7. Ceiling tile
8. Welding blankets
9. Cement sprayed on walls, ceilings, and structural supports
10. Joiner bulkhead paneling
11. Engine exhaust insulation
12. Insulation sprayed on air distribution ducting
13. Fire fighting suits
14. Gloves for hot work (i.e., welding and fire fighting)
15. Gaskets
16. Valve packing
17. Brake linings

using the air blowing technique exposes personnel to a high level of asbestos particles. Exposure of personnel to asbestos above the working environment exposure limit. shall be prevented by using a high-efficiency filtered vacuum cleaner equipped with a suction hose and brush attached to remove asbestos dust from the brake drums, assemblies and clutch assemblies prior to performing any maintenance. personnel engaged in brake or clutch maintenance work should wear a National Institute for Occupational Safety and Health (NIOSH) approved respirator as indicated in Table 1, enclosure (3) of this Circular.

2. Asbestos Gasket Fabrication. The exposure of personnel to asbestos above the PEL should be prevented by equipping the hand operated or power driven tool used to cut the asbestos with an approved filtered exhaust ventilation system. Personnel engaged in asbestos gasket fabrication should wear a NIOSH approved respirator as indicated in Table 1, enclosure (3) of this Circular.
3. Establish Regulated Areas. In locations where airborne concentrations of asbestos are likely to exceed the permissible exposure limits, the following measures should be applied:
 - a. Post the entrance. with warning signs that read:

"DANGER-ASBESTOS; CANCER AND LUNG DISEASE HAZARD;
AUTHORIZED PERSONNEL ONLY;
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA
 - b. Segregate the area from general use with plastic curtains, dust partitions or other method of demarcation so that unprotected personnel will not inadvertently enter and expose themselves.
 - c. Restrict access to only those personnel directly engaged in asbestos handling operations within the segregated area.
 - d. Provide respiratory protection in accordance with "Industrial Ventilation," (A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienist, Lansing, Michigan) whenever engineering controls and work practices are not sufficient to reduce employee exposure to asbestos at or below the PEL.
 - e. prohibit eating, drinking, smoking, chewing of tobacco or gum, and the application of cosmetics in the regulated area.
4. Wet Methods. Insofar as practical, asbestos should be handled, removed, cut, or otherwise worked in a wet state. Potable water with a small amount of detergent added should be used to improve the wetting characteristics and increase the asbestos fiber cohesion in the dry state. Commercial substances are also available.
5. Approved Power Operated Tools. The stryker cast cutter when used in conjunction with a high-efficiency filtered vacuum cleaner is the only power operated tool that should be used for removal of asbestos thermal insulation.

8. Vacuuming Or Wet Sweeping. Areas that become contaminated by asbestos insulation scrap and debris should be vacuum cleaned or should be wet down before sweeping to assist in the control of asbestos dust. Vacuum cleaners shall be a high-efficiency particulate air (HEPA) filtered type (see enclosure (7)). Dry sweeping asbestos debris and dust should never be performed.
9. Waste Handling Disposal. Asbestos waste, scrap, debris, equipment and asbestos contaminated clothing consigned for disposal should be collected, wetted, and disposed of in sealed impermeable bags. Such bags should be affixed with a warning label (see enclosure (7)) that reads:

"DANGER--CONTAINS ASBESTOS FIBERS;
AVOID CREATING DUST;
CANCER AND LUNG DISEASE HAZARD"

Waste asbestos material should be retained in sealed bags in a secure location or receptacle until disposed of by burial under a minimum of 2 feet of earth at a public landfill operated in accordance with 40 CFR 241. The vessel/facility owner/operator should coordinate with state and local authorities for any special regulation applicable to the disposal of asbestos materials.

10. Identification.
 - a. In place of other control procedures, a red undercoat sealer should be used to identify asbestos-free thermal insulation prior to final painting.
 - b. When installing asbestos-free thermal insulation, the glass cloth lagging should be secured to the insulation substrate with a coat of white adhesive. A sealer coat of red tinted adhesive should then be applied (see enclosure (7)); the exterior of the lagging should be painted in the conventional manner.

controls cannot feasibly be implemented to keep airborne concentrations of asbestos at or below the PEL. The selection and wearing should be done on the following basis:

- a. Selection of respirators should be made from among those that are jointly approved as being acceptable, for protection against asbestos exposure, by the Mine Safety and Health Administration (MSHA) and by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11. NIOSH certified equipment and equipment manufacturers are listed in DHHS (NIOSH) Publication No. 86-101 (or most recent edition). It can be ordered from NIOSH at the following address:

National Institute for Occupational Safety and Health
Publications Division
4676 Columbia Parkway
Cincinnati, OH 45226
Telephone No. (513) 841-4287

- b. If the work to be performed is likely to cause airborne concentrations of asbestos exceeding the PEL, the selection of respiratory protection should be based on the guidelines in 29 CFR 5190.1001(g)(2), Table 1, listed below. [NOTE: On May 12, 1987 (52 FR 17752) OSHA modified the respirator selection tables codified at 29 CFR 1910.1001 Table 1, and 1926.58 Table D-4 to specifically exclude the use of disposable respirators for use in areas with airborne concentrations not in excess of 2 f/cc.]

TABLE 1.—RESPIRATORY PROTECTION FOR ASBESTOS, TREMOLITE, ANTHOPHYLLITE, AND ACTINOLITE FIBERS

Airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals	Required respirator
Not in excess of 2 f/cc (10 X PEL).	1. Half-mask air-purifying respirator equipped with high-efficiency filters.
Not in excess of 10 f/cc (50 X PEL).	1. Full facepiece air-purifying respirator equipped with high-efficiency filters.
Not in excess of 20 f/cc (100 X PEL).	1. Any powered air-purifying respirator equipped with high-efficiency filters. 2. Any supplied-air respirator operated in continuous flow mode.
Not in excess of 200 f/cc (1000 X PEL).	1. Full facepiece supplied-air respirator operated in pressure demand mode.
Greater than 200 f/cc (> 1,000 X PEL) or unknown concentration.	1. Full facepiece supplied air respirator operated in pressure demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus.

NOTE: a. Respirators designed for higher environmental concentrations may be used at lower concentrations.
b. A high-efficiency filter means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers or larger.

the person or other personnel will be impaired by his use of a respirator.

- e. When using a supplied-air respirator, proper precautions must be taken to ensure that breathing quality air, of at least 19.5 percent oxygen, is supplied in accordance with recommendations in "Industrial Ventilation," (A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienist, Lansing, Michigan).
- f. ANSI Standards z88.2-1980 and Z88.6-1984 provide useful guidance for implementing respiratory protection programs and for medical evaluation of personnel that may be required to use respirators.

2. Protective Clothing. During all asbestos removal and repair operations, and during other asbestos operations for which environmental sampling is lacking or the sampling indicates the concentration of airborne asbestos may exceed the permissible exposure limit, the following protective clothing should be provided and should be required to be worn: disposable impermeable coveralls, hoods, gloves and foot coverings (see enclosure (7)). Safety glasses with side shields, vented goggles or a full-length face shield should be worn when full face respirators are not in use.

3. Disposition Of Used Protective Clothing. If clothing is used in an environment that exceeds the PEL of asbestos then the employer should either clean, launder, or otherwise dispose of the clothing in the following manner:

- a. On a regular basis, protective clothing must be collected in a sealable container, in the same manner as asbestos waste, before leaving the work site.
- b. Protective clothing must be treated as though they have been exposed to asbestos when sent out for cleaning or laundering, therefore, asbestos dust should not be blown or shaken from the clothing during cleaning process.
- c. The same personnel exposure limits apply to laundering and cleaning as in the repair and removal of asbestos, therefore, personnel involved in the cleaning and laundering of contaminated clothing must be kept informed of the asbestos exposure hazard and cleaning requirements.
- d. Contaminated clothes should be transported to cleaners, laundering facility or approved asbestos waste site in sealed asbestos containers labeled with the warning listed below:

"DANGER-CONTAINS ASBESTOS FIBERS;
AVOID CREATING DUST;
CANCER AND LUNG DISEASE HAZARD"

4. Change Areas. At locations where protective clothing is required, a change area should be provided as close as practical, but physically separate from the asbestos work area so that employees may change into their work clothes.

6. Recommended Hygienic Layout Of Regulated Areas.
 - a. Hygienic Facilities For Large Scale Asbestos Removal. The guidelines for erection of change area and shower facility adjacent to the work area are outlined in 29 CFR 51926.58, Appendix F, and should be used in laying out hygienic facilities for large scale removal of asbestos. See attachment 29 CFR 51926.58, Appendix F.
 - b. Mini-Enclosures For Small Scale Asbestos Removal. The guidelines for erection of a mini-enclosure are outlined in 29 CFR 51926.58, Appendix G, and should be used in laying out hygienic facilities for small scale removal or extensive repair of asbestos. See attachment 29 CFR 51926.58, Appendix G.
 - c. Use Of Glove Bags In Repair Involving Asbestos Insulation. Glove bags are single use control devices that are disposed of at the end of each job. Glove bag equipment, supplies, installation and work practices should be done in accordance with 29 CFR 51926.58, Appendix G, to prevent asbestos exposure in excess of the PEL. See attachment 29 CFR 51926.58, Appendix C.

Appendix E to § 1926.58—Interpretation and Classification of Chest Roentgenograms—Mandatory

(a) Chest roentgenograms shall be interpreted and classified in accordance with a professionally accepted classification system and recorded on a Roentgenographic Interpretation Form. *Form CSD/NIOSH (M) 2.8.

(b) Roentgenograms shall be interpreted and classified only by a B-reader, a board eligible/certified radiologist, or an experienced physician with known expertise in pneumoconioses.

(c) All interpreters, whenever interpreting chest roentgenograms made under this section, shall have immediately available for reference a complete set of the ILO-U/C International Classification of Radiographs for Pneumoconioses, 1980.

Appendix F to 1926.58—Work Practices and Engineering Controls for Major Asbestos Removal, Renovation, and Demolition Operations—Non-Mandatory

This is a non-mandatory appendix designed to provide guidelines to assist employers in complying with the requirements of 29 CFR 1926.58. Specifically, this appendix describes the equipment, methods, and procedures that should be used in major asbestos removal projects conducted to abate a recognized asbestos hazard or in preparation for building renovation or demolition. These projects require the construction of negative-pressure temporary enclosures to contain the asbestos material and to prevent the exposure of bystanders and other employees at the worksite. Paragraph (e)(6) of the standard requires that "... [W]henver feasible, the employer shall establish negative-pressure enclosures before commencing asbestos removal, demolition, or renovation operations." Employers should also be aware that, when conducting asbestos removal projects, they may be required under the National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61, Subpart M, or EPA regulations under the Clean Water Act.

Construction of a negative-pressure enclosure is a simple but time-consuming process that requires careful preparation and execution; however, if the procedures below are followed, contractors should be assured of achieving a temporary barricade that will protect employees and others outside the enclosure from exposure to asbestos and minimize to the extent possible the exposure of asbestos workers inside the barrier as well.

The equipment and materials required to construct these barriers are readily available and easily installed and used. In addition to

an enclosure around the removal site, the standard requires employers to provide hygiene facilities that ensure that their asbestos contaminated employees do not leave the work site with asbestos on their persons or clothing; the construction of these facilities is also described below. The steps in the process of preparing the asbestos removal site, building the enclosure, constructing hygiene facilities, removing the asbestos-containing material, and restoring the site include:

- (1) Planning the removal project;
- (2) Procuring the necessary materials and equipment;
- (3) Preparing the work area;
- (4) Removing the asbestos-containing material;
- (5) Cleaning the work area; and
- (6) Disposing of the asbestos-containing waste.

Planning the Removal Project

The planning of an asbestos removal project is critical to completing the project safely and cost-effectively. A written asbestos removal plan should be prepared that describes the equipment and procedures that will be used throughout the project. The asbestos abatement plan will aid not only in executing the project but also in complying with the reporting requirements of the USEPA asbestos regulations (40 CFR 61, Subpart M), which call for specific information such as a description of control methods and control equipment to be used and the disposal sites the contractor proposes to use to dispose of the asbestos containing materials.

The asbestos abatement plan should contain the following information:

- A physical description of the work area;
- A description of the approximate amount of material to be removed;
- A schedule for turning off and sealing existing ventilation systems;
- Personnel hygiene procedures;
- Labeling procedures;
- A description of personal protective equipment and clothing to be worn by employees;
- A description of the local exhaust ventilation systems to be used;
- A description of work practices to be observed by employees;
- A description of the methods to be used to remove the asbestos-containing material;
- The wetting agent to be used;
- A description of the sealant to be used at the end of the project;
- An air monitoring plan;
- A description of the method to be used to transport waste material; and
- The location of the dump site.

Materials and Equipment Necessary for Asbestos Removal

Although individual asbestos removal projects vary in terms of the equipment required to accomplish the removal of the material, some equipment and materials are common to most asbestos removal operations. Equipment and materials that should be available at the beginning of each project are: (1) rolls of polyethylene sheeting; (2) rolls of gray duct tape or clear plastic tape; (3) HEPA filtered vacuum(s); (4) HEPA-filtered portable ventilation system(s); (5) a wetting agent; (6) an airless sprayer; (7) a portable shower unit; (8) appropriate respirators; (9) disposable coveralls; (10) signs and labels; (11) pre-printed disposal bags; and (12) a manometer or pressure gauge.

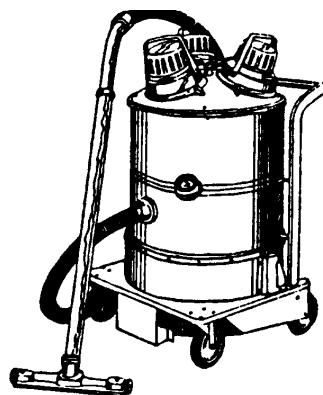
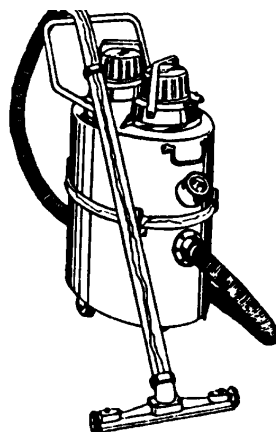
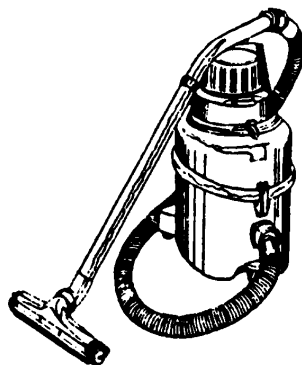
Rolls of Polyethylene Plastic and Tape.

Rolls of polyethylene plastic (6 mil in thickness) should be available to construct the asbestos removal enclosure and to seal windows, doors, ventilation systems, wall penetrations, and ceilings and floors in the work area. Gray duct tape or clear plastic tape should be used to seal the edges of the plastic and to seal any holes in the plastic enclosure. Polyethylene plastic sheeting can be purchased in rolls up to 12-20 feet in width and up to 100 feet in length.

HEPA-Filtered Vacuum. A HEPA-filtered vacuum is essential for cleaning the work area after the asbestos has been removed. Such vacuums are designed to be used with a HEPA (High Efficiency Particulate Air) filter, which is capable of removing 99.97 percent of the asbestos particles from the air. Various sizes and capacities of HEPA vacuums are available. One manufacturer, Nilfisk of America, Inc., produces three models that range in capacity from 5.25 gallons to 17 gallons (see Figure F-1). All of these models are portable, and all have long hoses capable of reaching out-of-the-way places, such as areas above ceiling tiles, behind pipes, etc.

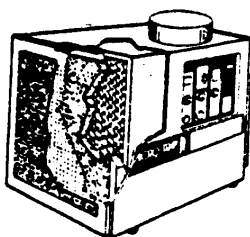
Exhaust Air Filtration System. A portable ventilation system is necessary to create a negative pressure within the asbestos removal enclosure. Such units are equipped with a HEPA filter and are designed to exhaust and clean the air inside the enclosure before exhausting it to the outside of the enclosure (See Figure F-2). Systems are available from several manufacturers. One supplier, Micro-Trap, Inc., has two ventilation units that range in capacity from 600 cubic feet per minute (CFM) to 1,700 CFM. According to the manufacturer's literature, Micro-Trap units filter particles of 0.3 micron in size with an efficiency of 99.99 percent. The number and capacity of units required to ventilate an enclosure depend on the size of the area to be ventilated.

* Mention of trade names or commercial products does not constitute endorsement or recommendation for use.



Source: Product Catalog, Asbestos Control Technologies, Inc., Maple Shade, N.J., 1985.

Figure F-1. HEPA Filtered Vacuums



Source: Product Catalog, Asbestos Control Technologies, Inc., Maple Shade, N.J., 1985.

Figure F-2. Portable Exhaust Ventilation System with HEPA Filter

Wetting Agents. Wetting agents (surfactants) are added to water (which is then called amended water) and used to soak asbestos-containing materials; amended water penetrates more effectively than plain water and permits more thorough soaking of the asbestos-containing materials. Wetting the asbestos-containing material reduces the number of fibers that will break free and become airborne when the asbestos-containing material is handled or otherwise disturbed. Asbestos-containing materials should be thoroughly soaked before removal is attempted; the dislodged material should feel spongy to the touch. Wetting agents are generally prepared by mixing 1 to 3 ounces of wetting agent to 5 gallons of water.

One type of asbestos, amosite, is relatively resistant to soaking, either with plain or amended water. The work practices of choice when working with amosite containing material are to soak the material as much as possible and then to bag it for disposal immediately after removal, so that the material has no time to dry and be ground into smaller particles that are more likely to liberate airborne asbestos.

In a very limited number of situations, it may not be possible to wet the asbestos-containing material before removing it. Examples of such rare situations are: (1)

Removal of asbestos material from a "live" electrical box that was oversprayed with the material when the rest of the area was sprayed with asbestos-containing coating; and (2) removing asbestos-containing insulation from a live steam pipe. In both of these situations, the preferred approach would be to turn off the electricity or steam, respectively, to permit wet removal methods to be used. However, where removal work must be performed during working hours, i.e., when normal operations cannot be disrupted, the asbestos-containing material must be removed dry. Immediate bagging is then the only method of minimizing the amount of airborne asbestos generated.

Airless Sprayer. Airless sprayers are used to apply amended water to asbestos-containing materials. Airless sprayers allow the amended water to be applied in a fine spray that minimizes the release of asbestos fibers by reducing the impact of the spray on the material to be removed. Airless sprayers are inexpensive and readily available.

Portable Shower. Unless the site has available a permanent shower facility that is contiguous to the removal area, a portable shower system is necessary to permit employees to clean themselves after exposure to asbestos and to remove any asbestos contamination from their hair and bodies. Taking a shower prevents employees from leaving the work area with asbestos on their clothes and thus prevents the spread of asbestos contamination to areas outside the asbestos removal area. This measure also protects members of the families of asbestos workers from possible exposure to asbestos. Showers should be supplied with warm water and a drain. A shower water filtration system to filter asbestos fibers from the shower water is recommended. Portable shower units are readily available, inexpensive, and easy to install and transport.

Respirators. Employees involved in asbestos removal projects should be provided with appropriate NIOSH-approved respirators. Selection of the appropriate respirator should be based on the

concentration of asbestos fibers in the work area. If the concentration of asbestos fibers is unknown, employees should be provided with respirators that will provide protection against the highest concentration of asbestos fibers that can reasonably be expected to exist in the work area. For most work within an enclosure, employees should wear half-mask dual-filter cartridge respirators. Disposable face mask respirators (single-use) should not be used to protect employers from exposure to asbestos fibers.

Disposable Coveralls. Employees involved in asbestos removal operations should be provided with disposable impervious coveralls that are equipped with head and foot covers. Such coveralls are typically made of Tyvek.¹ The coverall has a zipper front and elastic wrists and ankles.

Signs and Labels. Before work begins, a supply of signs to demarcate the entrance to the work area should be obtained. Signs are available that have the wording required by the final OSHA standard. The required labels are also commercially available as press-on labels and pre-printed on the 6-mil polyethylene plastic bags used to dispose of asbestos-containing waste material.

Preparing the Work Area

Preparation for constructing negative-pressure enclosures should begin with the removal of all movable objects from the work area, e.g., desks, chairs, rugs, and light fixtures, to ensure that these objects do not become contaminated with asbestos. When movable objects are contaminated or are suspected of being contaminated, they should be vacuumed with a HEPA vacuum and cleaned with amended water, unless they are made of material that will be damaged by the wetting agent; wiping with plain water is recommended in those cases where amended water will damage the object. Before the asbestos removal work begins, objects that

¹ Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

cannot be removed from the work area should be covered with a 6-mil-thick polyethylene plastic sheeting that is securely taped with duct tape or plastic tape to achieve an air-tight seal around the object.

Constructing the Enclosure

When all objects have either been removed from the work area or covered with plastic, all penetrations of the floor, walls, and ceiling should be sealed with 6-mil polyethylene plastic and tape to prevent airborne asbestos from escaping into areas outside the work area or from lodging in cracks around the penetrations. Penetrations that require sealing are typically found around electrical conduits, telephone wires, and water supply and drain pipes. A single entrance to be used for access and egress to the work area should be selected, and all other doors and windows should be sealed with tape or be covered with 6-mil polyethylene plastic sheeting and securely taped. Covering windows and unnecessary doors with a layer of polyethylene before covering the walls provides a second layer of protection and saves time in installation because it reduces the number of edges that must be cut and taped. All other surfaces such as support columns, ledges, pipes, and other surfaces should also be covered with polyethylene plastic sheeting and taped before the walls themselves are completely covered with sheeting.

Next a thin layer of spray adhesive should be sprayed along the top of all walls surrounding the enclosed work area, close to the wall-ceiling interface, and a layer of polyethylene plastic sheeting should be stuck to this adhesive and taped. The entire inside surfaces of all wall areas are covered in this manner, and the sheeting over the walls is extended across the floor area until it meets in the center of the area, where it is taped to form a single layer of material encasing the entire room except for the ceiling. A final layer of plastic sheeting is then laid across the plastic-covered floor area and up the walls to a level of 2 feet or so; this layer provides a second protective layer of plastic sheeting over the floor, which can then be

removed and disposed of easily after the asbestos-containing material that has dropped to the floor has been bagged and removed.

Building Hygiene Facilities

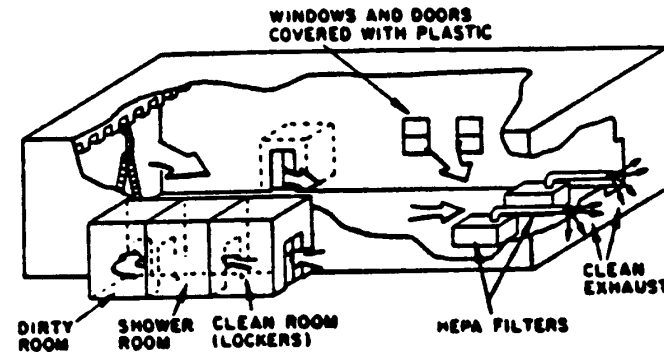
Paragraph (j) of the final standard mandates that employers involved in asbestos removal, demolition, or renovation operations provide their employees with hygiene facilities to be used to decontaminate asbestos-exposed workers, equipment, and clothing before such employees leave the work area. These decontamination facilities consist of:

- (1) A clean change room;
- (2) A shower; and

(3) An equipment room.

The clean change room is an area in which employees remove their street clothes and don their respirators and disposable protective clothing. The clean room should have hooks on the wall or be equipped with lockers for the storage of workers' clothing and personal articles. Extra disposable coveralls and towels can also be stored in the clean change room.

The shower should be contiguous with both the clean and dirty change room (see Figure F-3) and should be used by all workers leaving the work area. The shower should also be used to clean asbestos-contaminated equipment and materials, such as the outsides of asbestos waste bags and hand tools used in the removal process.



Source: EPA 1985. Asbestos Waste Management Guidance (EPA/530-SW-85-007).

Figure F-3. Cutaway View of Enclosure and Hygiene Facilities

The equipment room (also called the dirty change room) is the area where workers remove their protective coveralls and where equipment that is to be used in the work area can be stored. The equipment room should be lined with 6-mil-thick polyethylene plastic sheeting in the same way as was done in the

work area enclosure. Two layers of 6-mil polyethylene plastic sheeting that are not taped together from a double flap or barrier between the equipment room and the work area and between the shower and the clean change room (see Figure F-4).

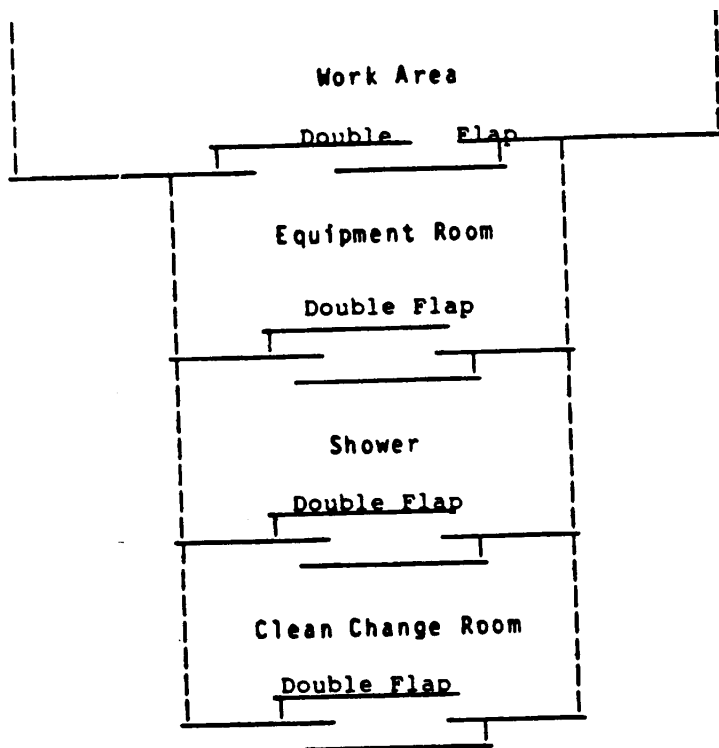


Figure F-4. Typical Hygiene Facility Layout

When feasible, the clean change room, shower, and equipment room should be contiguous and adjacent to the negative-pressure enclosure surrounding the removal area. In the overwhelming number of cases, hygiene facilities can be built contiguous to the negative-pressure enclosure. In some cases, however, hygiene facilities may have to be located on another floor of the building where removal of asbestos-containing materials is taking place. In these instances, the hygiene facilities can in effect be made to be contiguous to the work area by constructing a polyethylene plastic "tunnel" from the work area to the hygiene facilities.

Such a tunnel can be made even in cases where the hygiene facilities are located several floors above or below the work area; the tunnel begins with a double flap door at the enclosure, extends through the exit from the floor, continues down the necessary number of flights of stairs and goes through a double-flap entrance to the hygiene facilities, which have been prepared as described above. The tunnel is constructed of 2-inch by 4-inch lumber or aluminum struts and covered with 6-mil-thick polyethylene plastic sheeting.

In the rare instances when there is not enough space to permit any hygiene facilities

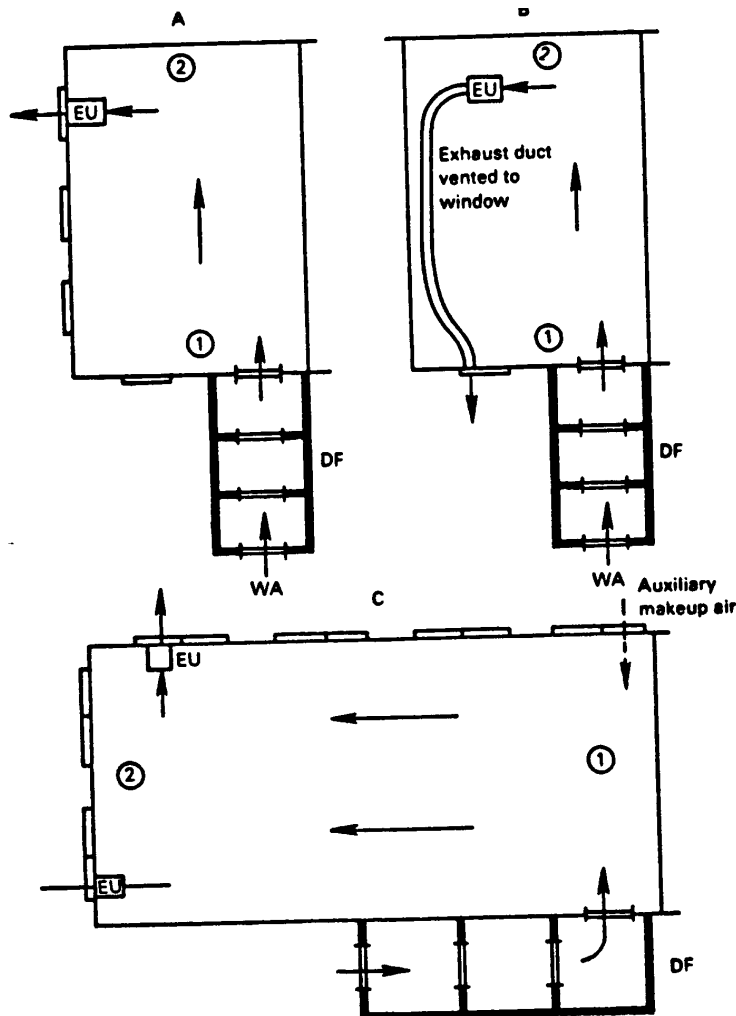
to be built at the work site, employees should be directed to change into a clean disposable worksuit immediately after exiting the enclosure (without removing their respirators) and to proceed immediately to the shower. Alternatively, employees could be directed to vacuum their disposable coveralls with a HEPA-filtered vacuum before proceeding to a shower located a distance from the enclosure.

The clean room, shower, and equipment room must be sealed completely to ensure that the sole source of air flow through these areas originates from uncontaminated areas outside the asbestos removal, demolition, or renovation enclosure. The shower must be drained properly after each use to ensure that contaminated water is not released to uncontaminated areas. If waste water is inadvertently released, it should be cleaned up as soon as possible to prevent any asbestos in the water from drying and becoming airborne in areas outside the work area.

Establishing Negative Pressure Within the Enclosure

After construction of the enclosure is completed, a ventilation system(s) should be installed to create a negative pressure within the enclosure with respect to the area outside the enclosure. Such ventilation systems must be equipped with HEPA filters to prevent the release of asbestos fibers to the environment outside the enclosure and should be operated 24 hours per day during the entire project until the final cleanup is completed and the results of final air samples are received from the laboratory. A sufficient amount of air should be exhausted to create a pressure of -0.02 inches of water within the enclosure with respect to the area outside the enclosure.

These ventilation systems should exhaust the HEPA-filtered clean air outside the building in which the asbestos removal, demolition, or renovation is taking place (see Figure F-5). If access to the outside is not available, the ventilation system can exhaust the HEPA-filtered asbestos-free air to an area within the building that is as far away as possible from the enclosure. Care should be taken to ensure that the clean air is released either to an asbestos-free area or in such a way as not to disturb any asbestos-containing materials.



Source: EPA 1985. Guidance for Controlling Asbestos-Containing materials in Buildings (EPA 860/5-65-024).

Figure F-5. Examples of Negative Pressure Systems. DF, Decontamination Facility; EU, Exhaust Unit; WA, Worker Access; A, Single-room work area with multiple windows; B, Single-room work area with single window near entrance; C, Large single-room work area with windows and auxiliary makeup air source (dotted arrow). Arrows denote direction of air flow. Circled numbers indicate progression of removal sequence.

A manometer or pressure gauge for measuring the negative pressure within the enclosure should be installed and should be monitored frequently throughout all work shifts during which asbestos removal, demolition, or renovation takes place. Several types of manometers and pressure gauges are available for this purpose.

All asbestos removal, renovation, and demolition operations should have a program

for monitoring the concentration of airborne asbestos and employee exposures to asbestos. Area samples should be collected inside the enclosure (approximately four samples for 5000 square feet of enclosure area). At least two samples should be collected outside the work area, one at the entrance to the clean change room and one at the exhaust of the portable ventilation system. In addition, several breathing zone

have the highest potential exposure to asbestos.

Removing Asbestos Materials

Paragraph (e)(6)(ii) requires that employers involved in asbestos removal, demolition, or renovation operations designate a competent person to:

- (1) Set up the enclosure;
- (2) Ensure the integrity of the enclosure;
- (3) Control entry to and exit from the enclosure;
- (4) Supervise all employee exposure monitoring required by this section;
- (5) Ensure the use of protective clothing and equipment;
- (6) Ensure that employees are trained in the use of engineering controls, work practices, and personal protective equipment;
- (7) Ensure the use of hygiene facilities and the observance of proper decontamination procedures; and
- (8) Ensure that engineering controls are functioning properly.

The competent person will generally be a Certified Industrial Hygienist, an industrial hygienist with training and experience in the handling of asbestos, or a person who has such training and experience as a result of on-the-job training and experience.

Ensuring the integrity of the enclosure is accomplished by inspecting the enclosure before asbestos removal work begins and prior to each work shift throughout the entire period work is being conducted in the enclosure. The inspection should be conducted by locating all areas where air might escape from the enclosure; this is best accomplished by running a hand over all seams in the plastic enclosure to ensure that no seams are ripped and the tape is securely in place.

The competent person should also ensure that all unauthorized personnel do not enter the enclosure and that all employees and other personnel who enter the enclosure have the proper protective clothing and equipment. He or she should also ensure that all employees and other personnel who enter the enclosure use the hygiene facilities and observe the proper decontamination procedures (described below).

Proper work practices are necessary during asbestos removal, demolition, and renovation to ensure that the concentration of asbestos fibers inside the enclosure remains as low as possible. One of the most important work practices is to wet the asbestos-containing material before it is disturbed. After the asbestos-containing material is thoroughly wetted, it should be removed by scraping (as in the case of sprayed-on or troweled-on ceiling material) or removed by cutting the metal bands or wire mesh that support the asbestos-containing material on boilers or pipes. Any residue that remains on the surface of the object from which asbestos is being removed should be wire brushed and wet wiped.

Bagging asbestos waste material promptly after its removal is another work practice control that is effective in reducing the airborne concentration of asbestos within the

enclosure. Whenever possible, the asbestos should be removed and placed directly into bags for disposal rather than dropping the material to the floor and picking up all of the material when the removal is complete. If a significant amount of time elapses between the time that the material is removed and the time it is bagged, the asbestos material is likely to dry out and generate asbestos-laden dust when it is disturbed by people working within the enclosure. Any asbestos-

contaminated supplies and equipment that cannot be decontaminated should be disposed of in pre-labeled bags; items in this category include plastic sheeting, disposable work clothing, respirator cartridges, and contaminated wash water.

A checklist is one of the most effective methods of ensuring adequate surveillance of the integrity of the asbestos removal enclosure. Such a checklist is shown in Figure F-6. Filling out the checklist at the beginning

of each shift in which asbestos removal is being performed will serve to document that all the necessary precautions will be taken during the asbestos removal work. The checklist contains entries for ensuring that:

- The work area enclosure is complete;
- The negative-pressure system is in operation;
- Necessary signs and labels are used;

BILLING CODE 4510-26-M

Asbestos Removal, Renovation, and Demolition Checklist

Date: _____ Location: _____
 Supervisor _____ Project # _____
 Work Area (sq. ft.) _____

	Yes	No
I. Work site barrier		
Floor covered	_____	_____
— Walls covered	_____	_____
Area ventilation off	_____	_____
All edges sealed	_____	_____
Penetrations sealed	_____	_____
Entry curtains	_____	_____
II. Negative Air Pressure		
HEPA Vac _____ Ventilation system _____		
Constant operation	_____	_____
Negative pressure achieved	_____	_____
III. Signs		
Work area entrance	_____	_____
Bags labeled	_____	_____
IV. Work Practices		
Removed material promptly bagged	_____	_____
Material worked wet	_____	_____
HEPA vacuum used	_____	_____
No smoking	_____	_____
No eating, drinking	_____	_____
Work area cleaned after completion	_____	_____
Personnel decontaminated each departure	_____	_____
V. Protective Equipment		
Disposable clothing used one time	_____	_____
Proper NIOSH-approved respirators	_____	_____
VII. Showers		
On site	_____	_____
Functioning	_____	_____
Soap and towels	_____	_____
Used by all personnel	_____	_____

Figure F-6. Checklist

- Appropriate work practices are used;
- Necessary protective clothing and equipment are used; and
- Appropriate decontamination procedures are being followed.

Cleaning the Work Area

After all of the asbestos-containing material is removed and bagged, the entire work area should be cleaned until it is free of all visible asbestos dust. All surfaces from which asbestos has been removed should be cleaned by wire brushing the surfaces, HEPA vacuuming these surfaces, and wiping them with amended water. The inside of the plastic

enclosure should be vacuumed with a HEPA vacuum and wet wiped until there is no visible dust in the enclosure. Particular attention should be given to small horizontal surfaces such as pipes, electrical conduits, lights, and support tracks for drop ceilings. All such surfaces should be free of visible dust before the final air samples are collected.

Additional sampling should be conducted inside the enclosure after the cleanup of the work area has been completed. Approximately four area samples should be collected for each 5000 square feet of enclosure area. The enclosure should not be

dismantled unless the final samples show asbestos concentrations of less than the final standard's action level. EPA recommends that a clearance level of 0.01 f/cc be achieved before cleanup is considered complete.

A clearance checklist is an effective method of ensuring that all surfaces are adequately cleaned and the enclosure is ready to be dismantled. Figure F-7 shows a checklist that can be used during the final inspection phase of asbestos abatement, removal, or renovation operations.

BILLING CODE 4510-20-M

Date: _____
Project: _____
Location: _____
Building: _____

Residual dust on:	<u>Yes</u>	<u>No</u>		<u>Yes</u>	<u>No</u>
a. Floor	_____	_____	e. Horizontal		
b. Horizontal			surfaces	_____	_____
surfaces	_____	_____	f. Pipes	_____	_____
c. Pipes	_____	_____	g. Ducts	_____	_____
d. Ventilation			h. Register	_____	_____
equipment	_____	_____	i. Lights	_____	_____

FIELD NOTES:
Record any problems encountered here.

[illegible]

FINAL AIR SAMPLE RESULTS: _____

Figure F-7. Clearance Checklist

and Engineering Controls for Small-Scale, Short-Duration Asbestos Renovation and Maintenance Activities—Non-Mandatory

This appendix is not mandatory, in that construction industry employers may choose to comply with all of the requirements of OSHA's final rule for occupational exposure to asbestos in the construction industry, § 1926.58. However, employers wishing to be exempted from the requirements of paragraphs (e)(6) and (f)(2)(iii)(B) of § 1926.58 shall comply with the provisions of this appendix when performing small-scale, short-duration renovation or maintenance activities. OSHA anticipates that employers in the electrical, carpentry, utility, plumbing, and interior construction trades may wish to avail themselves of the final standard's exemptions for small-scale, short-duration renovation and maintenance operations.

Definition of Small-Scale, Short-Duration Activities

For the purposes of this appendix, small-scale, short-duration renovation and maintenance activities are tasks such as, but not limited to:

- Removal of asbestos-containing insulation on pipes;
- Removal of small quantities of asbestos-containing insulation on beams or above ceilings;
- Replacement of an asbestos-containing gasket on a valve;
- Installation or removal of a small section of drywall;
- Installation of electrical conduits through or proximate to asbestos-containing materials.

Evidence in the record (see the Summary and Explanation section of the preamble for paragraph (g), Methods of Compliance, for specific citations) suggests that the use of certain engineering and work practice controls is capable of reducing employee exposures to asbestos to levels below the final standard's action level (0.1 f/cc). Several controls and work practices, used either singly or in combination, can be employed effectively to reduce asbestos exposures during small maintenance and renovation operations. These include:

- Wet methods;
- Removal methods

—Removal of entire asbestos insulated pipes or structures

—Use of mini-enclosures

- Enclosure of asbestos materials; and
- Maintenance programs.

This appendix describes these controls and work practices in detail.

Preparation of the Area Before Renovation or Maintenance Activities

The first step in preparing to perform a small-scale, short-duration asbestos renovation or maintenance task, regardless of the abatement method that will be used, is the removal from the work area of all objects that are movable to protect them from asbestos contamination. Objects that cannot be removed must be covered completely with a 6-mil-thick polyethylene plastic sheeting before the task begins. If objects have already been contaminated, they should be thoroughly cleaned with a High Efficiency Particulate Air (HEPA) filtered vacuum or be wet wiped before they are removed from the work area or completely encased in the plastic.

Wet Methods

Whenever feasible, and regardless of the abatement method to be used (e.g., removal, enclosure, use of glove bags), wet methods must be used during small-scale, short duration maintenance and renovation activities that involve disturbing asbestos-containing materials. Handling asbestos materials wet is one of the most reliable methods of ensuring that asbestos fibers do not become airborne, and this practice should therefore be used whenever feasible. As discussed in the Summary and Explanation section of the preamble for paragraph (g), Methods of Compliance, wet methods can be used in the great majority of workplace situations. Only in cases where asbestos work must be performed on live electrical equipment, on live steam lines, or in other areas where water will seriously damage materials or equipment may dry removal be performed. Amended water or another wetting agent should be applied by means of an airless sprayer to minimize the extent to which the asbestos-containing material is disturbed.

Asbestos-containing materials should be wetted from the initiation of the maintenance

should be used continually throughout the work period to ensure that any dry asbestos-containing material exposed in the course of the work is wet and remains wet until final disposal.

Removal of Small Amount of Asbestos-Containing Materials

Several methods can be used to remove small amounts of asbestos-containing materials during small-scale, short-duration renovation or maintenance tasks. These include the use of glove bags, the removal of an entire asbestos-covered pipe or structure, and the construction of mini-enclosures. The procedures that employers must use for each of these operations if they wish to avail themselves of the final rule's exemptions are described in the following sections.

Glove Bags

As discussed in the Summary and Explanation section of the preamble for paragraph (g), Methods of Compliance, evidence in the record indicate that the use of glove bags to enclose the work area during small-scale, short-duration maintenance or renovation activities will result in employee exposures to asbestos that are below the final standard's action level of 0.1 f/cc. This appendix provides requirements for glove-bag procedures to be followed by employers wishing to avail themselves of the standard's exemptions for each activities. OSHA has determined that the use of these procedures will reduce the 8 hour time weighted average (TWA) exposures of employees involved in these work operations to levels below the action level and will thus provide a degree of employee protection equivalent to that provided by compliance with all provisions of the final rule.

Glove Bag Installation. Glove bags are approximately 40-inch-wide times 64-inch-long bags fitted with arms through which the work can be performed (see Figure G-1(A)). When properly installed and used, they permit workers to remain completely isolated from the asbestos material removed or replaced inside the bag. Glove bags can thus provide a flexible, easily installed, and quickly dismantled temporary small work area enclosure that is ideal for small-scale asbestos renovation or maintenance jobs.

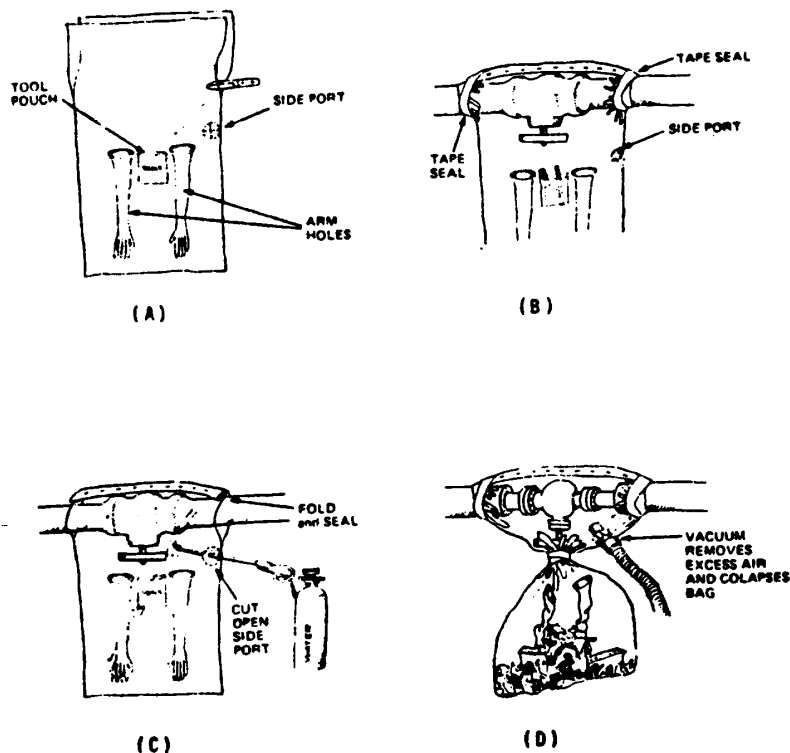


Figure G-1. Diagrams Showing Proper Use of Glove Bags in Small-Scale, Short-Duration Maintenance and Renovation Operations.

These bags are single use control devices that are disposed of at the end of each job. The bags are made of transparent 6-mil-thick polyethylene plastic with arms of Tyvek^{*} material (the same material used to make the disposable protective suits used in major asbestos removal, renovation, and demolition operations and in protective gloves). Glove bags are readily available from safety supply stores or specialty asbestos removal supply houses. Glove bags come pre-labeled with the asbestos warning label prescribed by OSHA and EPA for bags used to dispose of asbestos waste.

Glove Bag Equipment and Supplies.

Supplies and materials that are necessary to use glove bags effectively include:

- (1) Tape to seal the glove bag to the area from which asbestos is to be removed;
- (2) Amended water or other wetting agents;
- (3) An airless sprayer for the application of the wetting agent;

^{*} Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

- (4) Bridging encapsulant (a paste-like substance for coating asbestos) to seal the rough edges of any asbestos-containing materials that remain within the glove bag at the points of attachment after the rest of the asbestos has been removed;

- (5) Tools such as razor knives, nips, and wire brushes (or other tools suitable for cutting wires, etc.);

- (6) A HEPA filter-equipped vacuum for evacuating the glove bag (to minimize the release of asbestos fibers) during removal of the bag from the work area and for cleaning any material that may have escaped during the installation of the glove bag; and

- (7) HEPA-equipped dust cartridge respirators for use by the employees involved in the removal of asbestos with the glove bag.

Glove Bag Work Practices.

The proper use of glove bags requires the following steps:

- (1) Glove bags must be installed so that they completely cover the pipe or other structure where asbestos work is to be done. Glove bags are installed by cutting the sides of the glove bag to fit the size of the pipe from which asbestos is to be removed. The glove

open edges together and seal them with tape. All openings in the glove bag must be sealed with duct tape or equivalent material. The bottom seam of the glove bag must also be sealed with duct tape or equivalent to prevent any leakage from the bag that may result from a defect in the bottom seam (Figure G-1(B)).

- (2) The employee who is performing the asbestos removal with the glove bag must don a half mask dual-cartridge HEPA-equipped respirator; respirators should be worn by employees who are in close contact with the glove bag and who may thus be exposed as a result of small gaps in the seams of the bag or holes punched through the bag by a razor knife or a piece of wire mesh.

- (3) The removed asbestos material from the pipe or other surface that has fallen into the enclosed bag must be thoroughly wetted with a wetting agent (applied with an airless sprayer through the pre-cut port provided in most glove bags or applied through a small hole cut in the bag) (Figure G-1(C)).

- (4) Once the asbestos material has been thoroughly wetted, it can be removed from the pipe, beam or other surface. The choice of tool to use to remove the asbestos-containing material depends on the type of material to be removed. Asbestos-containing materials are generally covered with painted canvas and/or wire mesh. Painted canvas can be cut with a razor knife and peeled away from the asbestos-containing material underneath. Once the canvas has been peeled away, the asbestos-containing material underneath may be dry, in which case it should be re-sprayed with a wetting agent to ensure that it generates as little dust as possible when removed. If the asbestos-containing material is covered with wire mesh, the mesh should be cut with nips, tin snips, or other appropriate tool and removed.

A wetting agent must then be used to spray any layer of dry material that is exposed beneath the mesh, the surface of the stripped underlying structure, and the inside of the glove bag.

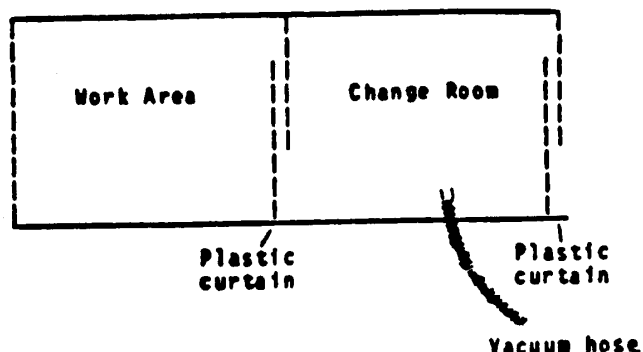
- (5) After removal of the layer of asbestos-containing material, the pipe or surface from which asbestos has been removed must be thoroughly cleaned with a wire brush and wet wiped with a wetting agent until no traces of the asbestos containing material can be seen.

- (6) Any asbestos containing insulation edges that have been exposed as a result of the removal or maintenance activity must be encapsulated with bridging encapsulant to ensure that the edges do not release asbestos fibers to the atmosphere after the glove bag has been removed.

- (7) When the asbestos removal and encapsulation have been completed, a vacuum hose from a HEPA filtered vacuum must be inserted into the glove bag through the port to remove any air in the bag that may contain asbestos fibers. When the air has been removed from the bag, the bag should be squeezed tightly (as close to the top as possible), twisted, and sealed with tape, to keep the asbestos materials safely in the bottom of the bag. The HEPA vacuum can

to be disposed of properly (Figure G-1(D)).

Top View



Side View

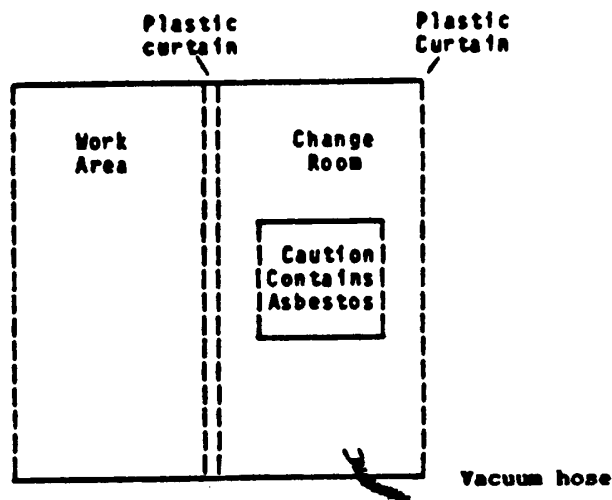


Figure G-2. Schematic of Mini-enclosure

Mini-Enclosures

In some instances, such as removal of asbestos from a small ventilation system or from a short length of duct, a glove bag may not be either large enough or of the proper shape to enclose the work area. In such cases, a mini-enclosure can be built around the area where small-scale, short-duration asbestos maintenance or renovation work is to be performed (Figure G-2). Such an

enclosure should be constructed of 6-mil-thick polyethylene plastic sheeting and can be small enough to restrict entry to the asbestos work area to one worker.

For example, a mini-enclosure can be built in a small utility closet when asbestos-containing duct covering is to be removed. The enclosure is constructed by:

(1) Affixing plastic sheeting to the walls with spray adhesive and tape;

sealing the plastic covering the floor to the plastic on the walls.

(3) Sealing any penetrations such as pipes or electrical conduits with tape; and

(4) Constructing a small change room (approximately 3 feet square) made of 6-mil-thick polyethylene plastic supported by 2-inch by 4-inch lumber (the plastic should be attached to the lumber supports with staples or spray adhesive and tape).

The change room should be contiguous to the mini enclosure, and is necessary to allow the worker to vacuum off his protective coveralls and remove them before leaving the work area. While inside the enclosure, the worker should wear Tyvek¹ disposable coveralls and use the appropriate HEPA filtered dual cartridge respiratory protection.

The advantages of mini-enclosures are that they limit the spread of asbestos contamination, reduce the potential exposure of bystanders and other workers who may be working in adjacent areas, and are quick and easy to install. The disadvantage of mini-enclosures is that they may be too small to contain the equipment necessary to create a negative pressure within the enclosure; however, the double layer of plastic sheeting will serve to restrict the release of asbestos fibers to the area outside the enclosure.

Removal of Entire Structures

When pipes are insulated with asbestos-containing materials, removal of the entire pipe may be more protective, easier, and more cost-effective than stripping the asbestos insulation from the pipe. Before such a pipe is cut, the asbestos-containing insulation must be wrapped with 6-mil polyethylene plastic and securely sealed with duct tape or equivalent. This plastic covering will prevent asbestos fibers from becoming airborne as a result of the vibration created by the power saws used to cut the pipe. If possible, the pipes should be cut at locations that are not insulated to avoid disturbing the asbestos. If a pipe is completely insulated with asbestos-containing materials, small sections should be stripped using the glove-bag method described above before the pipe is cut at the stripped sections.

Enclosure

The decision to enclose rather than remove asbestos-containing material from an area depends on the building owner's preference, i.e., for removal or containment. Owners consider such factors as cost effectiveness, the physical configuration of the work area, and the amount of traffic in the area when determining which abatement method to use.

If the owner chooses to enclose the structure rather than to remove the asbestos-containing material insulating it, a solid structure (airtight walls and ceilings) must be built around the asbestos covered pipe or structure to prevent the release of asbestos-containing materials into the area beyond the enclosure and to prevent disturbing these

¹ Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

materials by casual contact during future maintenance operations.

Such a permanent (i.e., for the life of the building) enclosure should be built of new construction materials and should be impact resistant and airtight. Enclosure walls should be made of tongue-and-groove boards, boards with spine joints, or gypsum boards having taped seams. The underlying structure must be able to support the weight of the enclosure. (Suspended ceilings with laid in panels do not provide airtight enclosures and should not be used to enclose structures covered with asbestos-containing materials.) All joints between the walls and ceiling of the enclosure should be caulked to prevent the escape of asbestos fibers. During the installation of enclosures, tools that are used (such as drills or rivet tools) should be equipped with HEPA-filtered vacuums. Before constructing the enclosure, all electrical conduits, telephone lines, recessed lights, and pipes in the area to be enclosed should be moved to ensure that the enclosure will not have to be re-opened later for routine or emergency maintenance. If such lights or other equipment cannot be moved to a new location for logistic reasons, or if moving them will disturb the asbestos-containing materials, removal rather than enclosure of the asbestos-containing materials is the appropriate control method to use.

Maintenance Program

An asbestos maintenance program must be initiated in all facilities that have asbestos-containing materials. Such a program should include:

- Development of an inventory of all asbestos-containing materials in the facility;
- Periodic examination of all asbestos-containing materials to detect deterioration;
- Written procedures for handling asbestos materials during the performance of small-scale, short-duration maintenance and renovation activities;
- Written procedures for asbestos disposal; and
- Written procedures for dealing with asbestos-related emergencies.

Members of the building's maintenance engineering staff (electricians, heating/air conditioning engineers, plumbers, etc.) who may be required to handle asbestos-containing materials should be trained in safe procedures. Such training should include at a minimum:

- Information regarding types of asbestos and its various uses and forms;
- Information on the health effects associated with asbestos exposure;
- Descriptions of the proper methods of handling asbestos-containing materials; and
- Information on the use of HEPA-equipped dual cartridge respiratory and other personal protection during maintenance activities.

Prohibited Activities

The training program for the maintenance engineering staff should describe methods of handling asbestos-containing materials as well as routine maintenance activities that are prohibited when asbestos-containing materials are involved. For example, maintenance staff employees should be instructed:

- *Not* to drill holes in asbestos-containing materials;
- *Not* to hang plants or pictures on structures covered with asbestos-containing materials;
- *Not* to sand asbestos-containing floor tile;
- *Not* to damage asbestos-containing materials while moving furniture or other objects;
- *Not* to install curtains, drapes, or dividers in such a way that they damage asbestos-containing materials;
- *Not* to dust floors, ceilings, moldings or other surfaces in asbestos-contaminated environments with a dry brush or sweep with a dry broom;
- *Not* to use an ordinary vacuum to clean up asbestos-containing debris;
- *Not* to remove ceiling tiles below asbestos-containing materials without wearing the proper respiratory protection, clearing the area of other people, and observing asbestos removal waste disposal procedures;
- *Not* to remove ventilation system filters dry; and
- *Not* to shake ventilation system filters.

Appendix H to § 1926.58—Substance Technical Information for Asbestos, Non-Mandatory

I. Substance Identification

A. Substance: "Asbestos" is the name of a class of magnesium-silicate minerals that occur in fibrous form. Minerals that are included in this group are chrysotile, crocidolite, amosite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos.

B. Asbestos, tremolite, anthophyllite, and actinolite are used in the manufacture of heat-resistant clothing, automotive brake and clutch linings, and a variety of building materials including floor tiles, roofing felts, ceiling tiles, asbestos-cement pipe and sheet, and fire-resistant drywall. Asbestos, tremolite, anthophyllite and actinolite are also present in pipe and boiler insulation materials, and in sprayed-on materials located on beams, in crawlspaces, and between walls.

C. The potential for an asbestos-containing product to release breathable fibers depends on its degree of friability. Friable means that the material can be crumbled with hand pressure and is therefore likely to emit fibers. The fibrous or fluffy sprayed-on materials used for fireproofing, insulation, or sound proofing are considered to be friable, and they readily release airborne fibers if disturbed. Materials such as vinyl-asbestos floor tile or roofing felts are considered nonfriable and generally do not emit airborne fibers unless subjected to sanding or sawing operations. Asbestos-cement pipe or sheet can emit airborne fibers if the materials are cut or sawed, or if they are broken during demolition operations.

D. Permissible exposure: Exposure to airborne asbestos, tremolite, anthophyllite, and actinolite fibers may not exceed 0.2 fibers per cubic centimeter of air (0.2 f/cc) averaged over the 8-hour workday.

II. Health Hazard Data

A. Asbestos, tremolite, anthophyllite, and actinolite can cause disabling respiratory

fibers are inhaled. Inhaling or ingesting fibers from contaminated clothing or skin can also result in these diseases. The symptoms of these diseases generally do not appear for 20 or more years after initial exposure.

B. Exposure to asbestos, tremolite, anthophyllite and actinolite has been shown to cause lung cancer, mesothelioma, and cancer of the stomach and colon. Mesothelioma is a rare cancer of the thin membrane lining of the chest and abdomen. Symptoms of mesothelioma include shortness of breath, pain in the walls of the chest, and/or abdominal pain.

III. Respirators and Protective Clothing

A. Respirators: You are required to wear a respirator when performing tasks that result in asbestos, tremolite, anthophyllite and actinolite exposure that exceeds the permissible exposure limit (PEL) of 0.2 f/cc. These conditions can occur while your employer is in the process of installing engineering controls to reduce asbestos, tremolite, anthophyllite and actinolite exposure, or where engineering controls are not feasible to reduce asbestos, tremolite, anthophyllite and actinolite exposure. Air-purifying respirators equipped with a high-efficiency particulate air (HEPA) filter can be used where airborne asbestos, tremolite, anthophyllite and actinolite fiber concentrations do not exceed 2 f/cc; otherwise, air-supplied, positive-pressure, full facepiece respirators must be used. Disposable respirators or dust masks are not permitted to be used for asbestos, tremolite, anthophyllite and actinolite work. For effective protection, respirators must fit your face and head snugly. Your employer is required to conduct fit tests when you are first assigned a respirator and every 6 months thereafter. Respirators should not be loosened or removed in work situations where their use is required.

B. Protective Clothing: You are required to wear protective clothing in work areas where asbestos, tremolite, anthophyllite, and actinolite fiber concentrations exceed the permissible exposure limit (PEL) of 0.2 f/cc to prevent contamination of the skin. Where protective clothing is required, your employer must provide you with clean garments. Unless you are working on a large asbestos, tremolite, anthophyllite, and actinolite removal or demolition project, your employer must also provide a change room and separate lockers for your street clothes and contaminated work clothes. If you are working on a large asbestos, tremolite, anthophyllite, and actinolite removal or demolition project, and where it is feasible to do so, your employer must provide a clean room, shower, and decontamination room contiguous to the work area. When leaving the work area, you must remove contaminated clothing before proceeding to the shower. If the shower is not adjacent to the work area, you must vacuum your clothing before proceeding to change the room and shower. To prevent inhaling fibers in contaminated change rooms and showers, leave your respirator on until you leave the shower and enter the clean change room.

operations will be conducted should be secured prior to the commencement of operations and should not be restarted until after clean-up operations have been completed. If necessary, temporary general exhaust ventilation to reduce airborne asbestos concentrations can be provided to these areas by exhausting the air through an approved ventilation system (one with high efficiency particulate air ("EPA) filters capable of trapping and retaining at least 99.97 percent of 0.3 micrometer diameter mono-disperse particles).

2. Local Exhaust Ventilation. Power operated tools used in asbestos work operations should be provided with a local exhaust ventilation system. Local exhaust ventilation should also be provided at the point of airborne fiber generations All local exhaust ventilation should exhaust through approved ventilation air filters.
3. Design, Construction And Operation. All asbestos ventilation systems should be designed, constructed and operated in accordance with criteria specified in: "Industrial Ventilation," (A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienist, Lansing, Michigan). A routine periodic testing and maintenance schedule should be conducted on all such equipment to assure proper system performance.

asbestos is deteriorated or damaged, air sampling should be conducted to determine the level of airborne asbestos fibers present. Except during casualty repairs, in each area where personnel may enter and airborne asbestos concentrations are likely to exceed the PEL's, air samples should be collected with such frequency and pattern to represent with reasonable accuracy the actual airborne concentration. Sampling should not be at intervals greater than 6 months. Exposure monitoring and sampling should be conducted as specified in 29 CFR 51910.1001(d). In evaluating asbestos exposures in repair or removal operations or other operations where asbestos is handled, samples should be taken in the workers' breathing zone as well as the general work environment to determine the 8-hour time weighted average (TWA) and peak exposures. Other exposures such as those outside the regulated area can be evaluated by sampling the general environment only. Records of asbestos environmental monitoring analytical results, vessel/facility location, origin of asbestos contaminants and costs of removal/repairs should be maintained on the vessel/facility. All procedures for sampling and analysis of samples should be done in accordance with 29 CFR 51910.1001, Appendix A or Appendix B.

2. Collecting Samples. Samples should be collected on a mixed cellulose ester filter membrane designated by the manufacturer as being suitable for collection and counting of asbestos, tremolite, anthophyllite and actinolite fibers (approximately 0.8 micrometer porosity). The filter should be mounted in a 25m cassette with an open faced 50 mm extension cowl; however, a 37 mm filter mounted cassette is acceptable as long as the variance is noted in the employee's exposure monitoring record. When collecting personnel samples, the holder should be fastened to the worker's lapel and air drawn through the filter by means of a battery powered personnel sampling pump. Sample air flow rate should be between 0.5 and 2.5 liter per minute for 25m filter mountings and between 1.0 and 2.5 liter per minute for 37m filter mountings. Eight-hour time weighted average exposure concentrations should be determined by taking samples of airborne concentrations of asbestos over at least an 8-hour period in any work shift. The peak exposure to airborne concentrations of asbestos should be evaluated from the results of several 15 minute samples taken throughout the work shift. If the filter darkens in appearance or loose dust is seen on the filter during sampling, another sample should be started with a new filter.
3. Pump Calibration. Each pump used for sample collection should be calibrated, both before and after sample collection, using a NIOSH approved method (i.e. the soap bubble calibration technique using a one-liter calibrated buret). To ensure accuracy, the calibration instrument must be connected to the pump following the same sequence of equipment which will be used in the actual sampling procedure.
4. Sample Analysis. Samples should be analyzed using phase contrast microscopy by a laboratory which is a current successful participant in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program for asbestos. All determinations of airborne concentrations of asbestos fiber should be made by the membrane filter method using a microscope with a blue or green filter at 400 to 450 power (magnification) in accordance with 29 CFR 51910.1001, Appendix A or Appendix B.

ALTERNATIVE CONTROL TECHNIQUES

LOCATIONS

ASBESTOS CONTAINING MATERIALS

1. Thermal Insulation:
May be loose, sprayed on, flexible, or pre-formed into batts, blankets, brick, boards, blocks, pipe section covers, etc.

- A. Thermal Insulation for piping and machinery.
Usually covered by lagging.

- A. Boilers, machinery and ancillary systems (e.g. turbines, diesel exhaust systems, heat exchangers, heating and refrigeration systems, ducting and piping) in machinery spaces, flats, fan rooms and as insulation on piping and ductwork throughout the ship.

- A. 1. Repair - limited deterioration/damage to lagging such as tears, dents, and gouges may be repaired in place with non-asbestos insulation, wire, cement, adhesive lagging, and sealers/coatings. Tape may be used for temporary repairs. Refractory brick, block and cement in fire boxes are usually repaired by patching with cement or removing the damaged sections and rebuilding the area with new materials.

- A. 2. Encapsulation - not recommended.

- A. 3. Enclosure - if material, location, and enclosure meet the criteria in the discussion section.

- A. 4. Removal - if deterioration/damage is caused by moisture, beyond repair, extensive, or may experience frequent disturbance.

- B. Thermal Insulation for spaces and compartment boundaries.
May be covered with other asbestos containing materials or with a sheathing of wood, marine veneer, metal, or board and paint/coating.

- B. Bulkheads, decks, overheads, doors bounding heated or refrigerated spaces; hull and superstructure boundaries exposed to the weather or sea.

- B. 1. Repair - minor repairs such as tears, dents and gouges may be repaired in place by patching with non-asbestos material.

- B. 2. Encapsulation - only if material, location and encapsulant meet the criteria in the discussion section.

- B. 3. Enclosure - if material, location, and enclosure meet the criteria in the discussion section.

- B. 4. Removal - if deterioration/damage is caused by moisture, beyond repair, may experience frequent disturbance or is extensive.

Generic description of materials containing asbestos that are routinely found aboard ship. Historically, asbestos has been used extensively throughout ships. These are likely locations - not an inclusive list.

ASBESTOS CONTAINING MATERIALS

LOCATION

ALTERNATIVE CONTROL TECHNIQUES

2. Fire Insulation:

May be sprayed on, loose (fiber), seal-rigid, faced or unfaced, or pre-formed into blankets, boards and panels.

A. Fire Insulation for fire boundaries.

A. Throughout the ship on bulkheads, decks, overheads, doors, hatches, beams and stiffeners in living and work areas. e.g. staterooms, mess and lounge areas, offices, lockers, storerooms, and passageways.

A. 1. Repair - All damaged fire insulation should be promptly repaired since the effectiveness of fire insulation is dependent upon maintaining its integrity. Minor repairs such as tears, dents, and gouges may be repaired in place by patching with non-asbestos material.

A. 2. Encapsulation - only if material, location and encapsulant meet the criteria in the discussion section.

A. 3. Enclosure - Fire insulation board e.g. asbestos board paneling is usually non friable. If raw edges are exposed and subject to disturbance, they should be taped, caulked, or otherwise sealed to prevent the release of friable fibers.

A. 4. Removal - if deterioration/damage is caused by moisture, beyond repair, extensive, or may experience frequent disturbance. Removal beyond the deteriorated/damaged section are not always recommended.

B. Electrical Insulation.

B. Generators, motors, electrical panels and boards, and electrical distribution systems.

B. 1. Repair - All damaged electrical insulation should be promptly repaired since the effectiveness of insulation is dependent upon maintaining its integrity. This does not authorize repairs that would not otherwise be permitted by the regulations or good marine practice.

B. 2. Encapsulation - not recommended.

B. 3. Enclosure - not recommended.

B. 4. Removal - if deterioration/damage is caused by moisture, beyond repair, may experience frequent disturbance or is extensive.

ASBESTOS CONTAINING MATERIALS	LOCATION	ALTERNATIVE CONTROL TECHNIQUES
3. Thermal Cement: Compound used as joint cement, patching cement, etc.	A. Thermal insulation covering valves, flanges, piping elbows, and similar complex shaped equipment.	<p>A. 1. Repair - Usually repaired by patching with non-asbestos cement or removing the damaged sections and rebuilding the area with new materials.</p> <p>A. 2. Encapsulation - Not Recommended.</p> <p>A. 3. Enclosure - Not Recommended.</p> <p>A. 4. Removal - Disruption for maintenance of the insulated item should be handled as a removal with appropriate disposal and replacement with non-asbestos mat'l.</p>
4. Asbestos Compounds: Fire/water sealants(e.g.Duxseal), caulking, putties, and adhesives.	A. Potentially throughout the vessel.	<p>A. 1. Repair - Undisturbed, these compounds are generally considered non-frangible and do not require control. Patch damaged/deteriorated areas with non-asbestos materials.</p> <p>A. 2. Encapsulation - Not necessary but may be encapsulated if material, location, and encapsulant meet the criteria in the discussion section.</p> <p>A. 3. Enclosure - Not necessary but may be enclosed if material, location, and the enclosure meet the criteria in the discussion section.</p> <p>A. 4. Removal - If disturbed remove, dispose and replace with non-asbestos material.</p>
5. Asbestos Tile: Vinyl/asbestos and asphalt/asbestos floor tile, ceiling tile and tile cement.	A. Potentially throughout the vessel.	<p>A. 1. Repair - Undisturbed, these compounds are considered non-frangible. For those section subject to localized erosion, e.g. ceiling tile located at or near an air plenum, near a forced air stream or around a lighting fixture - localized removal and replacement may be the most economical control method.</p> <p>A. 2. Encapsulation - May be encapsulated if material, location, and encapsulant meet the criteria in the discussion section.</p> <p>A. 3. Enclosure - May be enclosed if material, location, and the enclosure meet the criteria in the discussion section.</p> <p>A. 4. Removal - If disturbed remove, dispose, and replace with non-asbestos material.</p>

ASBESTOS CONTAINING MATERIALS	LOCATION	ALTERNATIVE CONTROL TECHNIQUES
6. Asbestos Textiles: Cloth, fire blankets, welding blankets, gloves, fire-fighting suits, etc.	A. Potentially throughout the vessel, but usually stored in machinery spaces, fire and maintenance lockers.	<p>A. 1. Repair - Intact, they are considered to be non-frangible and usually do not require control. Damaged/deteriorated items should be replaced with non-asbestos containing mat'ls.</p> <p>A. 2. Encapsulation - N/A.</p> <p>A. 3. Enclosure - N/A.</p> <p>A. 4. Removal - Asbestos containing materials that are not permanently installed should be replaced with non-asbestos materials.</p>
7. Asbestos gaskets, packing and brake linings.	A. Machinery for high temperature applications, and stored in machinery storage lockers and spaces.*	<p>A. 1. Repair - Replacement with non-asbestos substitutes if available.</p> <p>A. 2. Encapsulation - N/A.</p> <p>A. 3. Enclosure - N/A.</p> <p>A. 4. Removal - if damaged/deteriorated beyond use, remove and replace with non-asbestos substitutes if available.</p>

* If no acceptable substitute exists, long term storage of these items may be required. Storage should be in individually sealed packages containers to preclude accidental damage and subsequent release of asbestos fibers.

sufficient to maintain asbestos exposure at or below the PEL then respirators should be used that have been jointly approved for protection against asbestos exposure by the Mine Safety and Health Administration (MSHA) and by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11. Selection of respiratory protection should be based on the same guidelines outlined in paragraph 1.b. of enclosure (3), Table 1 in 29 CFR 51910.1001(g)(2). NIOSH offers a publication, DHHS (NIOSH) Publication No. 86-101 (or most recent edition), that lists certified respiratory equipment and equipment manufacturers. The publication can be ordered from NIOSH at the following address:

National Institute for Occupational Safety and Health
Publications Division
4676 Columbia Parkway
Cincinnati, OH 45226
Telephone No. (513) 841-4287

2. Items Required For Removal Or Repair Work.

- a. Disposable Coveralls. Impermeable suit with drawstring hood, elastic "wrists and attached non-skid shoes.
- b. Gloves. Surgeons, rubber, sterile and disposable.
- c. Glove Bags. For use in small scale repairs or removal of asbestos glove bags may be used that have been pre-labeled with the asbestos warning label prescribed by OSHA and EPA for bags used to dispose of asbestos waste. Installation and use of glove bags should be done in accordance with Appendix G in 29 CFR 51926.58.
- d. High-Efficiency Particulate Air (HEPA) Filtered Vacuum Cleaner. Use vacuums designed to accept high-efficiency particulate air filters, that will remove and retain at least 99.97 percent of 0.3 micrometer diameter mono-disperse particles, for clean up of asbestos debris.
- e. Impermeable Plastic Bags. For waste disposal and contaminated laundry collection the bags should be red in color with an approximate dimension of 19.5" x 38" and not less than 0.0025" thickness.
- f. Labels. Labels for impermeable plastic bags should read as follows:

"DANGER-CONTAINS ASBESTOS FIBERS;
AVOID CREATING DUST;
CANCER AND LUNG DISEASE HAZARD"
- g. Line. Any type of line at least 0.25" diameters used to restrict access into regulated areas.
- h. Overshoes. Rubber with non-skid 501e8.

surfaces identifying non-asbestos insulation.

- k. Signs. Posted at the entrance to regulated areas, yellow with black lettering stating:

"DANGER-ASBESTOS; CANCER AND LUNG DISEASE HAZARD;
AUTHORIZED PERSONNEL ONLY;
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA"

- 1. Tape. Use masking tape of 1.5 to 2 inch width to seal the sleeves, cuffs and other openings in protective clothing. Use gray duct or clear plastic tape to seal edges and any holes of the working and hygienic enclosure around the regulated area.
- m. Water Sprayer. Used to wet asbestos during repair work. Addition of a wetting agent or surfactant, such as liquid detergent is recommended to keep the asbestos fibers from becoming airborne once the solution dries.

ASBESTOS EXPOSURE CONTROL TRAINING

1. The National Institute for Occupational Safety and Health offers several courses that may be of benefit to personnel who work with asbestos. For information, contact:

National Institute for Occupational Safety and Health
Attn: Training Registrar
Division of Training and Manpower Development
4676 Columbia Parkway
Cincinnati, OH 45226
Telephone No. (513) 533-8225

2. Some courses offered include:
 - a. Occupational Respiratory Protection #593
 - b. Industrial Hygiene Measurements #550
 - c. Industrial Hygiene Sampling, Decision Making, Monitoring and Recordkeeping:
Sampling Strategies #553
 - d. Sampling and Evaluating Airborne Asbestos Dust #582
 - e. Introduction of Occupational Safety #508
 - f. Gas, Vapor and Particulate Sampling #592

MEDICAL MONITORING AND SURVEILLANCE GUIDELINES

1. Medical Monitoring Action Level. All employees who will or have been exposed to airborne concentrations of asbestos at or above the action level, 0.1 fibers per cubic centimeter over an 8-hour time weighted average (TWA), should be included in the Asbestos Medical Surveillance Program:
2. Medical Surveillance.
 - a. A preplacement evaluation of all personnel who have been or will be assigned to a position involving exposure to asbestos fiber at or above the action level should be conducted by medical examination. This examination should be performed within 30 days of assignment to an environment subject to asbestos exposure and should include the following:
 - (1) A comprehensive medical and work history detailing prior exposure to potentially harmful chemical or physical respiratory hazards, particularly asbestos. Any adverse effects related to these exposures should be recorded. A respiratory history with emphasis on any symptoms of respiratory ailments should also be recorded. This information should be recorded in Part 1 of the attached Medical Surveillance Questionnaire.
 - (2) A complete physical examination with emphasis on the digestive tract, the respiratory system and cardiovascular system.
 - (3) A 14x17 posterior-anterior chest roentgenogram. These films should be interpreted and classified in accordance with current professional radiological practices. In addition, films should be interpreted in accordance with the ILO-U/C International Classification of Radiographs of Pneumoconiosis, 1980.
 - (4) Pulmonary function tests including forced expiratory volume in one second (FEV1.0) and forced vital capacity (FVC).
 - (5) The physician's judgment of a worker's ability to use respiratory protective equipment. The ANSI Z88.6-1984 standard (RESPIRATORY PROTECTION: Physical Standards and Medical Monitoring) provides useful information about physical examinations to determine a person's ability to safely use a respirator.
 - (6) Any other tests deemed appropriate by the examining physician with respect to evaluating an employee's suitability to being exposed to an asbestos contaminated environment.

The findings of severe respiratory impairment from any cause, e.g., FEV1.0/FVC less than 45 percent or FVC less than 70 percent of predicted or the presence of documented actual or probable pulmonary asbestosis, should be disqualifying for initial assignment. Any other abnormalities discovered in the course of the preemployment evaluation should be investigated to determine if they could substantially increase the risk of asbestos-induced disease.

- b. Annual periodic and termination of employment examinations should be conducted in the manner specified in subparagraph 2.a. above with the exception of subparagraph 2.a.(1) above, the Medical Surveillance Questionnaire, and subparagraph 2.a.(3) above, the chest roentgenogram. Only part 2 of the Medical Surveillance Questionnaire should

be completed during the annual periodic and termination of employment examinations. The chest roentgenogram should be administered no sooner than the intervals listed in the table below, 29 CFR 1910.1001(l)(3)(ii), Table 2, following the preplacement evaluation.

TABLE 2.—FREQUENCY OF CHEST ROENTGENOGRAMS

Years since first exposure	Age of employee		
	15 to 35	35+ to 45	45+
0 to 10.....	Every 5 years	Every 5 years	Every 5 years.
10+	Every 5 years	Every 2 years	Every 1 year.

- c. Personnel should be notified of any abnormalities detected by screening tests (during the preplacement, periodic, or termination of employment examination) and the medical record should specifically indicate, by date and the initials of the physician and patient, that such notification was made. If the records indicate that the employee has received an annual physical examination within the past 12 months, a termination of employment examination is not required.
- d. When an individual is no longer exposed to airborne concentrations of asbestos exceeding the action level (0.1 fiber/cc) he should continue to receive medical monitoring if any of the following conditions exist:
 - (1) Regularly smokes one or more cigarettes per day and 5 years accumulated exposure to asbestos; or
 - (2) Has any asbestos-associated disorder.
- e. An individual not currently exposed to asbestos at or above the action level and believes he has been exposed to asbestos in the past, should complete both parts of the attached Medical Surveillance Questionnaire. Based on the review of this questionnaire the individual may be requested to have a complete medical examination as outlined in subparagraph 2.a. above, the preplacement evaluation. If the results warrant, the individual should be placed in the Medical Surveillance Program. If the results are negative, the individual should be recalled in 5 years for re-examination.

Appendix to 29 CFR §1910.1001, Attachment to Enclosure (9) to NVIC 6-87
Medical Surveillance Questionnaire

Federal Register / Vol. 51, No. 119 / Friday, June 20, 1986 / Rules and Regulations

22747

Part 1
INITIAL MEDICAL QUESTIONNAIRE

1. NAME _____

2. SOCIAL SECURITY # 1 2 3 4 5 6 7 8 9 _____

3. CLOCK NUMBER 10 11 12 13 14 15 _____

4. PRESENT OCCUPATION _____

5. PLANT _____

6. ADDRESS _____

7. _____ (Zip Code) _____

8. TELEPHONE NUMBER _____

9. INTERVIEWER _____

10. DATE 16 17 18 19 20 21 _____
Month Day Year 22 23 24 25 26 27 _____

11. Date of Birth _____

12. Place of Birth _____

13. Sex 1. Male _____ 2. Female _____

14. What is your marital status? 1. Single _____ 4. Separated/Divorced _____
2. Married _____ 3. Widowed _____

15. Race 1. White _____ 4. Hispanic _____
2. Black _____ 5. Indian _____
3. Asian _____ 6. Other _____

16. What is the highest grade completed in school? _____
17A. Have you ever worked full time (30 hours per week or more) for 6 months or more? 1. Yes _____ 2. No _____

IF YES TO 17A:
B. Have you ever worked for a year or more in any dusty job? 1. Yes _____ 2. No _____
3. Does Not Apply _____

Specify job/industry _____ Total Years Worked _____
Max dust exposure: 1. Mild _____ 2. Moderate _____ 3. Severe _____

C. Have you ever been exposed to gas or chemical fumes in your work? 1. Yes _____ 2. No _____
Specify job/industry _____ Total Years Worked _____
Max exposure: 1. Mild _____ 2. Moderate _____ 3. Severe _____

D. What has been your usual occupation or job—the one you have worked at the longest? _____

1. Job occupation _____

2. Number of years employed in this occupation _____

3. Position/job title _____

4. Business, field or industry _____

(Record on lines the years in which you have worked in any of these industries, e.g. 1960-1969)

Have you ever worked: YES NO

E. In a mine? _____

F. In a quarry? _____

G. In a foundry? _____

H. In a pottery? _____

I. In a cotton, flax or hemp mill? _____

J. With asbestos? _____

18. PAST MEDICAL HISTORY

A. Do you consider yourself to be in good health? YES NO

If "NO" state reason _____

B. Have you any defect of vision? _____

If "YES" state nature of defect _____

C. Have you any hearing defect? _____

If "YES" state nature of defect _____

Appendix to 29 CFR §1910.1001, Attachment to Enclosure (9) to NVIC 6-87
Medical Surveillance Questionnaire

22748 Medical Surveillance Questionnaire
Federal Register / Vol. 51, No. 119 / Friday, June 20, 1986 / Rules and Regulations

<p>d. Are you suffering from or have you ever suffered from:</p> <p>a. Epilepsy (or fits, seizures, convulsions)? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>b. Rheumatic fever? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>c. Kidney disease? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>d. Bladder disease? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>e. Diabetes? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>f. Jaundice? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>		<p>3A. Hay Fever?</p> <p>IF YES TO 3A:</p> <p>B. Was it confirmed by a doctor? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>C. At what age did it start? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>
<p>19. CHEST COLDS AND CHEST ILLNESSES</p> <p>19A. If you get a cold, does it usually go to your chest? (Usually means more than 1/2 the time) <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>20A. During the past 3 years, have you had any chest illnesses that have kept you off work, indoors at home, or in bed? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>		<p>23A. Have you ever had chronic bronchitis?</p> <p>IF YES TO 23A:</p> <p>B. Do you still have it? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>C. Was it confirmed by a doctor? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>D. At what age did it start? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>
<p>B. Did you produce phlegm with any of these chest illnesses? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>C. In the last 3 years, how many such illnesses with (increased) phlegm did you have which lasted a week or more? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>		<p>24A. Have you ever had emphysema?</p> <p>IF YES TO 24A:</p> <p>B. Do you still have it? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>C. Was it confirmed by a doctor? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>D. At what age did it start? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>
<p>21. Did you have any lung trouble before the age of 16? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>22. Have you ever had any of the following?</p> <p>1A. Attacks of bronchitis? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>		<p>25A. Have you ever had asthma?</p> <p>IF YES TO 25A:</p> <p>B. Do you still have it? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>C. Was it confirmed by a doctor? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>D. At what age did it start? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>
<p>B. Was it confirmed by a doctor? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>C. At what age was your first attack? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>		<p>E. If you no longer have it, at what age did it stop? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>
<p>2A. Pneumonia (include bronchopneumonia)? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>IF YES TO 2A:</p> <p>B. Was it confirmed by a doctor? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>		<p>26. Have you ever had:</p> <p>A. Any other chest illness? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p> <p>If yes, please specify _____</p>
<p>C. At what age did you first have it? <input type="checkbox"/> 1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/></p>		